scatter the rays of shorter wave length, thus leaving the orange-red rays predominant in the emergent light. This view was speedily verified by a critical examination of the track of the traversing beam. A sensible turbidity was visible, in the darkened room, at the extremities of the column of water adjacent to the corks securing the glass plates; and the light diffused latterly at these portions, when examined by Nicol's prism, was found to be distinctly polarized. The emergent beam examined by the spectroscope, exhibited orange and red in full intensity; but the yellow and green were greatly diminished. Ten days later (January 2, 1879) the solar beam traversing the same column of water emerged much brighter than on Christmas day, and the tint was orange tinged with yellow and red. This long repose caused, doubtless, some of the resinous precipitate to become more generally diffused, or to subside, and thus diminished the turpidity of the liquid. The recognition of the dichroism imparted to water by the presence of finely-divided particles in suspension, serves, likewise, to harmonize the conflicting views promulgated by physicists who have studied the chromatic phenomena presented by this liquid. Some claim that the rays of higher refrangibility are more copiously withdrawn by absorption; while others maintain that the rays of longer wave lengths are more absorbed. In many cases the chromatic tints ascribed to selective molecular absorption are unquestionably due to selective diffuse reflection from the ultra-microscopical corpuscles which are held in suspension. (Vide Jamin's "Cours de Physique," 3d ed., tome 3, p. 447, *et seq.*)

ON THE IMPORTANCE OF ENTOMOLOGICAL STUDIES.*

"Occasionally, at the present day, we may hear insects and entomologists spoken of as 'bugs' and 'bug-hunters'—epithets applied in derision to what are regarded as petty objects and trivial pursuits. Such views only betray an ignorance which is equally pitiable and inexcusable. The study of insects has assumed an importance in its direct application to agriculture, horticulture and sylviculture, second to no other department of natural history. It has called to its aid some of the best intellect of the country. Its literature has become extensive and assumed a high rank. Our State governments, in response to demands made upon them, are appointing State Entomologists. Our General Government is making liberal appropriations for entomological work in the Department of Agriculture at Washington, and also for sustaining a special United States Entomological Commission, now in the third year of its operations, charged with the investigation of a few of our more injurious insects.

"The study of insects assumes an importance in this country far greater than in any other part of the world. No where else does mother earth yield in such variety and in such abundance her agricultural products; after supplying to repletion our own people, the excess is distributed to every quarter of the globe. Few, surprisingly few, of these varied products are native to our soil. Nearly all of our fruits, grasses, cereals and vegetables, and perhaps three-fourths of our weeds are of foreign importation—mainly from Europe. With their introduction, very many of the insects that preyed upon them were also introduced, or have been subsequently brought hither. But unfortunately for us, the parasites which preyed upon them and kept them under control, have for the most part, been left behind. As the result, the imported pests, in their new home, find their favorite food-plants spread out in luxuriant growth over broad acres, where they may ply their destructive work without hindrance or molestation, until some native parasites acquire the habit of preying upon them.

"The grand scale upon which our crops are grown as no where else in the world—demanding for their gathering the invention of special mechanical contrivances, and that horse power should be replaced by steam—has also as its attendant inevitable evil, an enormous increase of insect depredations. This may be illustrated by a reference to our apple-tree insects. * * * * * * "In like manner, any and every crop cultivated on a large scale offers strong invitation to insect attack, and wonderfully stimulates insect multiplication."

PROFESSOR J. A. LINTNER.

* From an address before The Farmers' Club, Onondaga Co. N. Y.

CLOUD COLORS.

This P. M., from about 3.30 to sunset, I was witness to a remarkably vivid display of cloud-colors; and thinking that a full description of the phenomena may perhaps help to the understanding of the conditions of the higher atmosphere, I have written out what I saw. The day had been the warmest of the season. The night before was cloudy, and the temperature hardly fell below the freezing point. Light clouds prevailed through the day; at 3.30 the standard and maximum thermometers stood together at 62°, while the maximum sun thermometer registered 119°. The day had been quite still, the direction of the very light wind being from the S. E. The clouds in the neighborhood of the sun were of two varieties, the lower a fleecy and tufted cloud of the cumulus order, moving pretty rapidly from a little north of west, and frequently exhibiting a rapid spiral movement in the filaments, the other would be called cirro-stratus, though not precisely the typical cloud of that name, as portions were quite free from any appearance of structure. In the less dense portions an arrangement in parallel fibres was, however, quite apparent,—one set nearly horizontal, the other inclined at about 45°, the south end upward. The horizontal arrangement predominated, while the other was visible here and there in a detached streamer and occasionally in striæ upon the longer belts, which, hence, were not, as is usual with this cloud, striated perpendicularly to the direction of the bands. These cirro-stratus clouds, which also moved from the west, though with a much less velocity than the lower ones, were the only clouds which showed the rainbow colors. These were exceedingly intense, and changing every moment with such rapidity as to make it very difficult to decide upon the order of the colors, the more so as every filament had its own rainbow, and all were shifting. The red was, however, generally nearest the sun, though sometimes bordered inwardly with intense yellow. The most perfect succession of colors which I caught was in a cloud extending horizontally northward from the sun, in which for a brief interval all the seven colors could be traced following one another, not in the direction of the sun, but vertically, the red uppermost. The violet was, however, so very brilliant as to suggest the beginning of a new rainbow at its bottom, and in a moment this cloud had adopted the form which was most common throughout,—bands of red above and below, with a broader band between of yellow or green or blue. This blue tint was often exceedingly brilliant, tipping both ends of filaments, which were of dull hue in the centre, and bordered above and below with parallel stripes of red. A purple shade was occasionally distinct, surrounded by other colors. This undescribably beautiful display continued over the whole S. W. quarter of the sky, until the sun had been out of sight behind the mountains for more than half an hour.

Though the clouds upon which the colors were observed were of the order in which halos are formed, yet the appearance had very little in common with the halo,—of which we have had a good example within a week. The colors were not only not concentric, but were exhibited successively by different clouds in every direction from the sun, and *at all distances*, from 30°, or, perhaps, 40°, to

not more than 3° or 4°. In fact, about four o'clock the transmitted light was of a splendid green color, tinting the white walls of my room as though through the stained glass of a church. About the time I first noted the colors a strong north wind sprung up, continuing in gusts through the afternoon. F. H. LOND.

COLORADO SPRINGS, *January* 29, 1881.

NOTE ON DR. HENRY DRAPER'S PHOTOGRAPH OF THE NEBULA IN ORION.*

BY MR. RANYARD.

*Read before the Royal Astronomical Society, Jan. 14, 1881.

Dr. Draper has sent me an enlarged copy of a photograph of the nebula in Orion, which he succeeded in taking on the night of the 30th of September last. Dr. Draper remarks that September is not the best time of the year, so that he hopes to obtain still better results next summer. The photograph was taken with an exposure of 51 minutes. He does not mention the instrument with which it was taken, but I conclude that it was with his great 27-inch reflector. On the photograph are nine white spots of various sizes; these represent 13 stars in and about the nebula, for the four stars of the trapezium are merged together by reason of over-exposure. In the corner is another small photograph taken with a shorter exposure, and showing three of the four stars of the trapezium. This is not the first occasion on which the stars of the trapezium have been photographed. I, and no doubt many others, have succeeded in obtaining photographs of them. But it is, I believe, the first photograph in which any trace of the nebula is shown. And Dr. Draper may, I think, be very much congratulated on the great success he has attained. The photograph shows the whole of the brighter nucleus of the nebula—sometimes referred to as the "Fish's head." I have compared it with the different drawings of the nebula by Bond, Herschel, Liaponnov, Lassell, Secchi, the Earl of Rosse, and Tempel, and find that it does not correspond exactly with any of them. The drawings differ very greatly amongst themselves, and they differ in type as well as in minor details. They do not appear to differ continuously in order of time, so that the drawings do not afford any proof that the form of the nebula is changing. Photographs will of course afford much more valuable evidence with respect to any such change in the future. The photograph does not show any stars of less than the 9½ magnitude, showing that the brighter masses of the nebula registered themselves on the plate when stars of the 10th magnitude left no trace. If in the future some much more sensitive method of photographing is devised, it will be necessary to contrive some plan by which the brighter parts of the nebula and the light of the brighter stars may be cut off from the sensitive plate during the greater part of the exposure, so as to prevent the irradiation from the brighter parts encroaching over the area occupied by the fainter parts. At present, however, we are very far from being able to photograph, with the sensitive silver compounds* made use of, all that can be seen with the human eye. But even if photography does not make any further advances, photographs such as these will be of very great value in showing the relative brightness of the brighter parts of the nebula.

Mr. Common: I do not agree with Mr. Ranyard, that we must look to photography to explain or prove any change in the form of the nebulæ, because various kinds of plates give different results, and you would not have the same effects produced by the same colored light. I should rely much more on accurate drawings than upon any photographs. If we compare these drawings, here you have [pointing to Father Secchi's drawing] a dark mass with a slope of light running from the left-hand corner down to the right hand. In the other [Lord Rosse's drawing] there is no division, except a large space divided into channels. The latter is wrong and the former clearly right. Before you give details you ought to represent the chief features of the nebula, because it is the features that most readily indicate change. With regard to Mr. Ranyard's remark that no star smaller than the 10th magnitude is shown, there are, I think, two—these fainter stars under the trapezium, which are certainly less than the 10th magnitude.

Mr. Ranyard: I have here the magnitudes given by Liaponnov, and he gives one as the 9th magnitude and the other as the 9th to the 10th magnitude.

Mr. Common: Before we can discuss this photograph we want to know the instrument it is taken with, the focal length, in order to know the size of the image, and the kind of plates used, and the mode of development. If you want to detect any change in the form of the nebulæ you must entirely rely on the hand drawings.

Mr. Ranyard: I think that some considerable scientific use may be made of these photographs; they will at least enable us to compare the relative brightness of the different masses of the nebula as shown on any one photograph, for as far as we know, there is no great difference in the spectrum of different parts of the nebula, and so we have no reason to suppose that the photographic effects of different parts of the nebula in any one photograph would not be proportional to the light.

Mr. Stone: With regard to discrepancies in drawings, I never knew two persons asked to make a drawing of the same faint object make them exactly alike. It is evident that observers draw that which happens to arrest their attention, and one feature will strike one observer, while the attention of another is attracted by something else. A very good instance of this occurred during the eclipse of 1874. Two observers were sitting side by side drawing the corona. The one drew a small nearly quadrilateral corona, while the other drew a large corona with great rays in the equatorial regions. Before a totality was over the observer who had drawn the small corona looked at his neighbor's drawing, and, on looking up again at the corona, recognized the outline which his neighbor had drawn, and commenced to put it on paper when the eclipse ended. There is therefore a great element of uncertainty about drawings, one observer overlooks one part, or is struck by one part, and another by something else.

Mr. Rand Capron: I think that Mr. Commom is right, that photographs of objects taken with different instruments and plates will probably never usefully bear comparison; but I agree with Mr. Ranyard that photographs of the same object taken from time to time with the same instrument and the same plates can most usefully be compared.

Mr. Burton said: I should like to suggest that the difficulty which Mr. Ranyard has referred to, with regard to the irradiation from stars interfering with the fainter parts of the nebula, might be got over by placing a prism of small angle, made of quartz or Iceland spar, between the object-glass and the photographic plate. The images of the stars would be drawn out into lines, while there would be three or four images of the nebula which would not interfere. The principal plane of the prism might then be turned round into a different position-angle, and another photograph taken, so that the spectra of the stars would fall in another direction.

Mr. De La Rue said: I recollect very well the time when the Earl of Rosse's drawing was made. I compared

*[Note by Mr. Ranyard.] It seems probable that the small pencil of light, which passes through the pupil of the eye from the faintest object perceived, produces an actual change in the matter of the rods and cones, which is rapidly obliterated by the circulation and vital processes going on about the retina. This is now, I believe, pretty generally agreed to by physiologists. If in the future the matter acted upon in the rods and cones can be isolated, and the change produced by light can be rendered permanent, it seems probable that, by means of large lenses and reflectors, we may some day obtain photographs of objects too faint to be visible with the naked eye.